

Remarks and Arguments

Reconsideration is respectfully requested.

Claims 1, 3, 8, and 21-26 are pending in the present application before this amendment. No new matter has been added.

The undersigned attorney telephoned both the examiner and his supervisor (June 11, 2010) in which proposed amendments were discussed and where it was agreed that there would be no need to file an RCE with the proposed amendments. However, the applicant has subsequently decided to prosecute the application without any further amendments to the claims.

In the office action (page 2), claims 1, 3 and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Publication No. 2004/0048591 (Kim) in view of U.S. Publication No. 2003/0119467 (Welland).

The applicants respectively disagree and submit that the claims, as they now stand, are in condition for allowance.

The main feature of the present invention is that it uses a digital frequency control voltage (VDT) signal only or the VDT signal and an analog frequency control voltage (VAT) signal both, in order to control at least one of the receive amplifier, the receive mixer, the transmit mixer and the transmit amplifier. At least one of them has a resonant unit, which is controlled by only the VDT signal or by both the VDT and VAT signals (please see pages 8-9, paragraph [45] of the specification).

1. Differences between the present invention and "Welland"

First, Examiners pointed out that "Welland et al. disclose the oscillator is a digital analog tuning voltage controlled oscillator for providing the output resonant frequency, f_{LO} (VCO 400 is a digital analog VCO as disclosed in fig. 5 and further disclosed in paragraphs 56-60)".

However, Welland is related to a "frequency synthesizer". That Welland includes VCO 400 and outputs an out resonant frequency, f_{LO} , is not unique composition at all, but it is just what a general frequency synthesizer would be like in terms of composition.

On the other hand, the present invention is related to direct conversion RF front-end receiver, and the field of the invention is different from Welland. Although the frequency synthesizer is included in a part of the direct conversion RF front-end receiver, it is just the means for generating digital and analog control signal for controlling the oscillators of the transmit/receive signal path (LNA, Mixer, PA, etc.).

Second, Examiners pointed out that "VCO is controlled by VAT and VDT signals (Vc and Bc signals as disclosed in fig. 5)". However, this is a general characteristic of the VCO in the frequency synthesizer.

In the present invention, out resonant frequency, f_{LO} , that is output from VCO is controlled by an oscillator control signal. Also, the oscillator control signal for controlling the VCO is applied to LNA, Down mixer, Up mixer or PA, and controls their oscillator circuits to vary the oscillator frequency.

That is, Welland merely proposes a structure of a general frequency synthesizer. Welland does not disclose at all the characteristics of the present invention which uses a digital frequency control voltage (VDT) signal only or the VDT signal and an analog frequency control voltage (VAT) signal both, in order to control at least one of the receive amplifier, the receive mixer, the transmit mixer and the transmit amplifier.

2. Differences between the present invention and "Kim"

Kim and the present invention are related to the technology for handling wideband signals by the conventional narrowband signals handling wireless communications transmitter-receiver which is implemented in low noise amplifiers, up/down mixers, power amplifiers, and frequency synthesizers.

Since Kim uses an analog control signal, Varactor is used when implementing a resonator of the transmit/receive signal path. But because the non-linear device, varactor, significantly reduces linearity of a signal, it is realistically difficult to implement the wireless communications transmitter-receiver that handles wideband signals.

However, the present invention implements the resonator of the transmit/receive signal path with a digital control resonator and controls it digitally using the frequency synthesizer. As a result, performance of the transmitter-receiver has been much more clearly improved than Kim that uses the varactor.

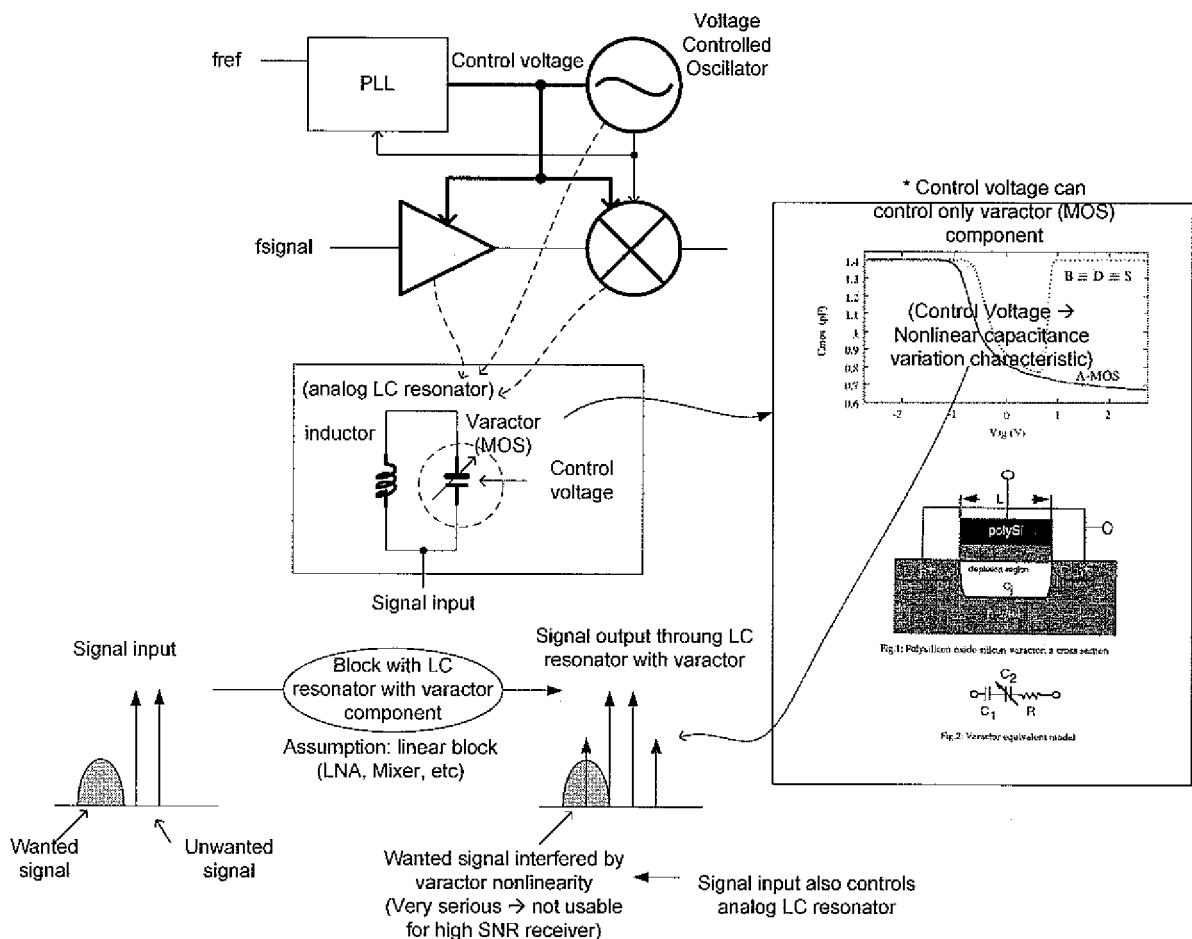
Furthermore, the present invention recognizes the linearity problem that was caused by operation of the transmitter-receiver when the reception signal is applied and proposes a way to solve the problem. On the other hand, Kim does not recognize the problem at all and therefore a person of ordinary skill in the art would not be able to easily invent the present invention from Kim.

As stated before there are substantial differences between Kim and the present invention and the effects of the present invention.

According to Kim, when the signal having the frequency of f_{signal} passes through the analog LC resonator, the signal is distorted by the nonlinear capacitance variation characteristic of the Varactor. Thereby, it is difficult to get high SNR.

This is because, in Kim, only control voltage which is an analog signal is used to control a LNA (low noise amplifier) and a down mixer. Accordingly, the Varactor should be used in the LC resonator of the LNA and the down mixer because only analog signal is used. And, the Varactor receives a signal input as well as the control voltage, and according to the magnitude of the signal input, the capacitance of the Varacotr is changed, thereby, increasing the Varactor's nonlinear characteristic. And this characteristic increases distortion of the signal.

The below figure is a graph to explain the above problem. It is assumed that other characteristics of the LNA and the Mixer in the graph have linearity in order to explain the problem of the analog voltage control.



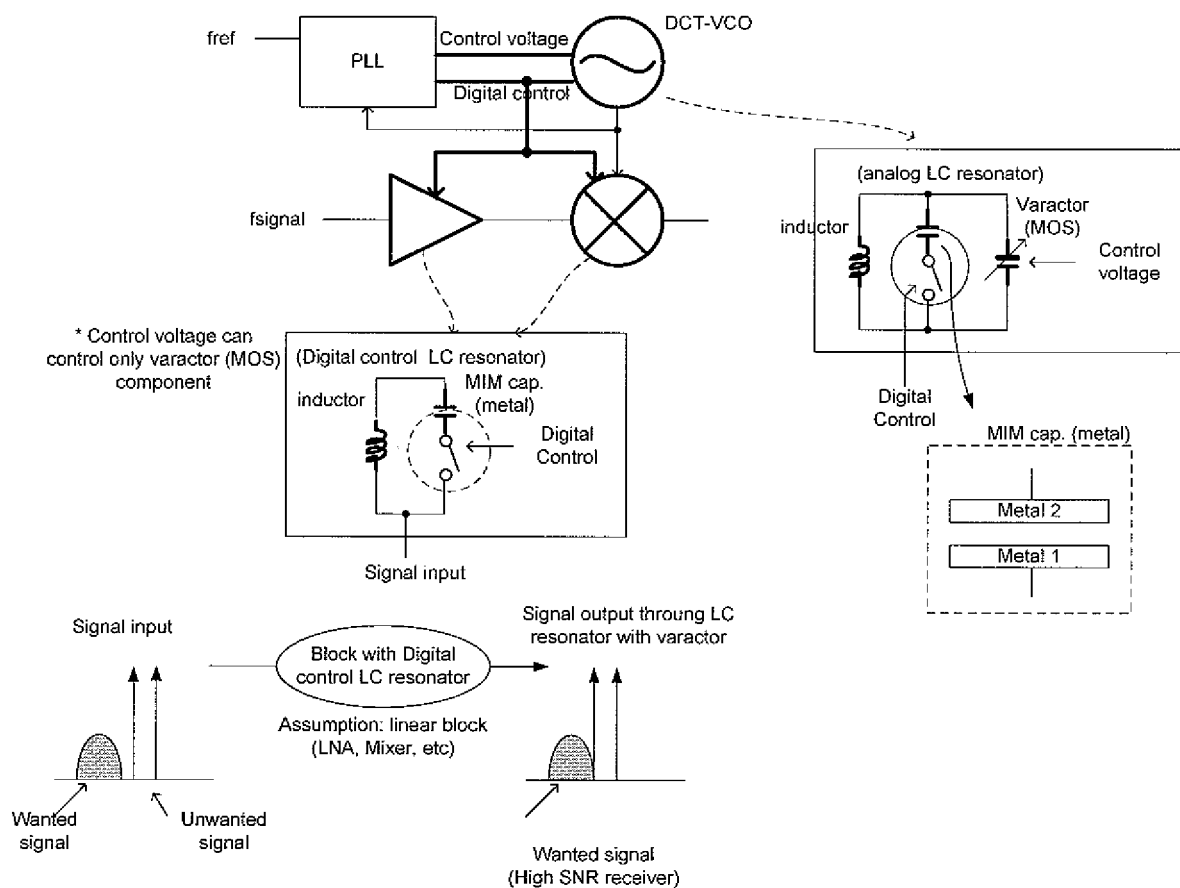
On the other hand, in accordance with the present invention, one of the receive amplifier and the receive mixer has the resonant unit controlled by only the VDT signal or by both the VDT signal and the VAT signal.

When the signal having the frequency of f_{signal} passes through the receive amplifier or the receive mixer of the present invention, the signal is far less distorted than those of Kim, because the LC resonator is controlled by a digital signal. The

transceiver of the present invention can decrease the signal distortion to level of a transceiver which does not use the control signal from PLL whereas Kim has problem in the signal distortion. That is, the present invention has unexpected technical advantage the cited references do not teach and disclose.

And, because, when both the VDT and VAT signal are used to control, the varactor can be smaller than the varactor controlled by only the analog signal, the RF front-end transceiver according to the present invention can be designed with a significantly reduced area, so that it is very competitive with respect to the costs.

The below figure is a graph to explain the above technical feature. It is assumed that other characteristics of the LNA and the Mixer in the graph have linearity in order to explain the problem of the analog voltage control.



3. Conclusion

In light of the above, it is clear that none of the references cited by the Examiner disclose the feature of the present invention and therefore a person of ordinary skill in the art would not be able to easily invent the present invention even from combination of Kim and Welland.

Also in the office action (page 4), claims 21, 23 and 25 are indicated as allowable if rewritten in independent form.

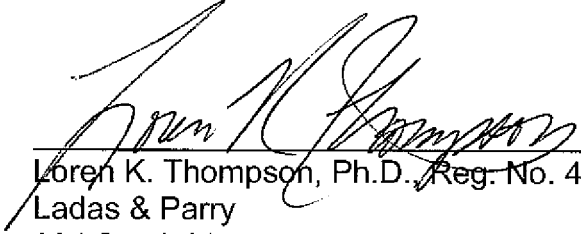
The applicants appreciate the examiner for recognizing allowable subject matter in these dependent claims 21, 23 and 25. However, as argued above, the applicants submit that all of the claims, including claims 21, 23, and 25, are already in condition for allowance.

For the reasons set forth above, the applicants respectfully submits that claims 1, 3, 8, and 21-26, now pending in this application, are in condition for allowance over the cited references. Accordingly, the applicants respectfully requests reconsideration and withdrawal of the outstanding rejections and earnestly solicits an indication of allowable subject matter.

This response is considered to be responsive to all points raised in the office action. Should the examiner have any remaining questions or concerns, the examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,

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